

# Publish GIS maps on the web

## The implementation of ArcGIS Server

Monica Peggion, Marcelo Masera, Alberto Atzori

*European Commission*

*Joint Research Centre, Ispra (Italy)*



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# 1. INTRODUCTION: THE GEOGRAPHIC INFORMATION SYSTEMS

## 1.1 General concepts

GIS (Geographic Information Systems) are a collection of computer hardware, software, and geographic data for capturing, managing, analyzing, and displaying all forms of geographically referenced information.

The most important additional value of GIS is that instead of providing pages full of numbers and other bits of data, as traditional instruments did, they show maps, with defined accuracy, where important geographical features are put in relation to the surrounding area.

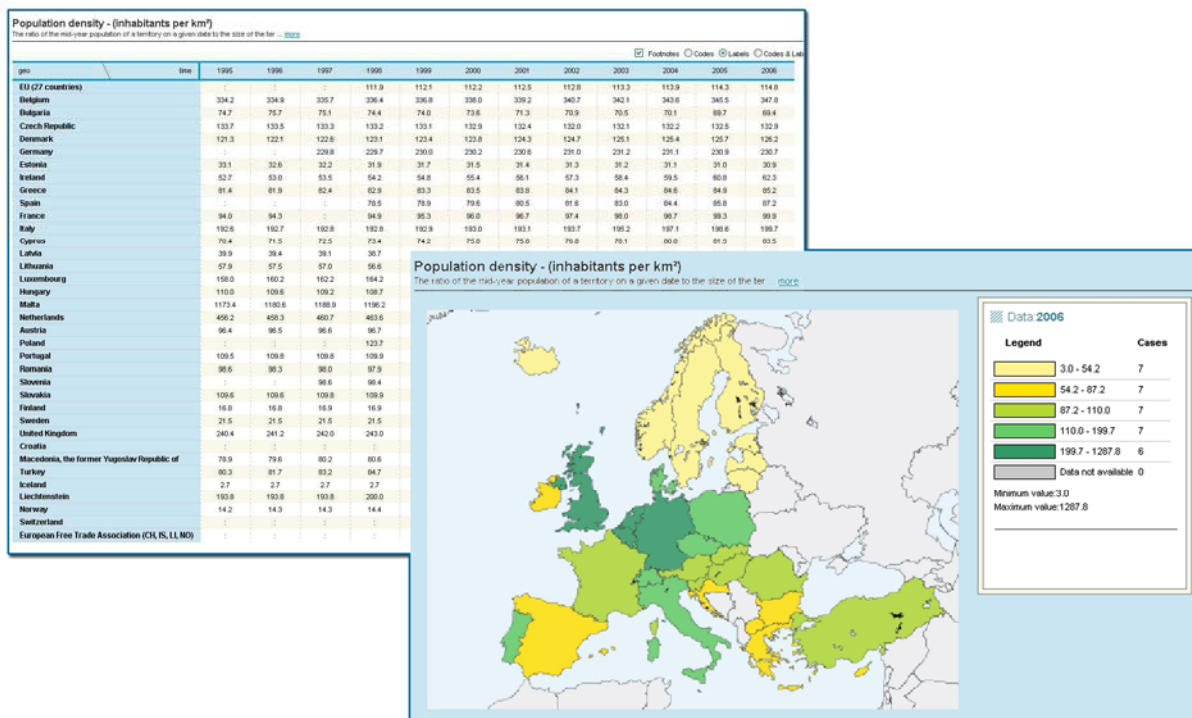


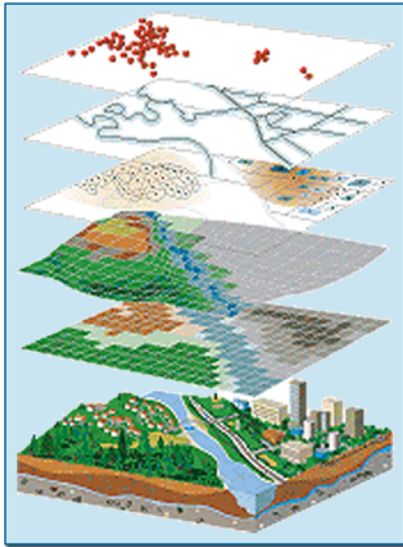
Fig. 1.1.1 The same dataset (population density) visualized as a table sheet or as a map (Eurostat)

Geographic Information Systems (GIS) can be seen from two viewpoints: the supporting technology and their application to problem solving.

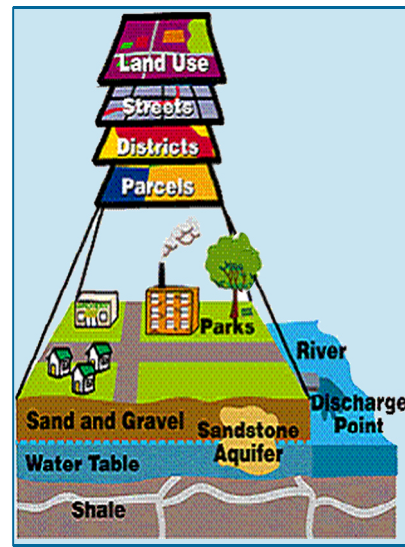
GIS can be considered as a special-purpose digital database in which a common spatial coordinate system is the primary means of storing and accessing data and information. GIS systems have the ability to perform numerous tasks utilizing both the spatial and attribute data stored within them.

The following functions distinguish GIS from other management information systems: GIS allow integrating varieties of geographical technologies, such as remote sensing, global positioning systems, etc.

GIS are relevant tools for supporting decision making. The way in which data are entered, stored, and analysed within a GIS must mirror the way that information will be used for a specific analysis or decision-making task.



*Fig. 1.1.2 Different levels of information can be overlaid in a GIS project*



*Fig. 1.1.3 Link between attributes and location data*

With GIS, one can link information (attributes) to location data, such as people to addresses, buildings to parcels, or streets within a network. One can then layer that information to give a better understanding of how it all works together. One chooses what layers to combine based on what questions need an answer.

A regular map only shows spatial data such as lakes, roads, and vegetation. GIS goes further by linking attribute data to spatial data. For example, address ranges and street names can be linked to street segments. This link creates "intelligent" map features and provides the ability to analyze spatial data, giving the possibility to use map data in a whole new way.

Why are GIS so helpful? They can incorporate many components in one framework:

- Maps;
- geographic features and relationships;
- results of data analysis;
- databases store;
- technical data related to the infrastructures;
- environmental data (physical and chemical information, land use,...).

Since GIS are as easy to use as regular maps, almost anyone can use a GIS. So not only it is a useful tool for supporting policies, but they can also be useful tools for educating the public on policy matters. Normally people are not going to understand several pages full of complicated land-use data, but they will be able to understand a simple map, with straightforward keys that explain the different areas within the map.

If the map shows the streets in an area, then citizens can not only see the information, but relate it to the reality that they know and perhaps where they live. People will be better empowered to understand whether something will affect them. For instance, the local citizenry may be more inclined to agree to a zoning change if they could see which properties will be affected. It may be much harder to convince the local population with a large batch of numbers, or a simple assurance that one is telling them the truth.

GIS are a very important tool for the policy maker. It can show as little or as much detail as needed in a form most people can understand. With its ability to be easily understood, GIS enable policy makers to convey the information to the public. This allows the public the opportunity not only to understand what is going on, but enables them to be informed and provide feedback, which is as important to the policy politician as it is to the policy analyst.

## 1.2 Web GIS services and the Geoweb

When GIS data and functionality are made available over the Internet, the system is referred to as "Web GIS". With Web GIS, users do not need to purchase and install expensive GIS software in order to access and work with maps and databases. In addition, users do not need to become experts in sophisticated GIS applications, since the

functionality is made available through a regular web browser and an integrated Viewer with a simple, user-friendly interface.

With the advent of Java based programming, software applications for web-based GIS work are now readily available. Some of these programs require the user to buy some software, and others require plug-ins to be added to web browsers, but others don't require any special software additions at all. They only use the capabilities of the web browsers.

Internet based geographical data services involve management spatial and non-spatial (attribute) data.

GIS technology has long been valued for enhancing communication and collaboration in decision making, effectively managing resources and assets, enhancing the efficiency of workflows, improving the accessibility of information, and generally offering tangible cost savings to organizations both large and small. In an effort to deliver geospatial information and functionality throughout an enterprise, many organizations are choosing to extend their desktop GIS implementations with server-based GIS solutions that provide content and capabilities via Web services.

Technically, Web services are modular applications that correspond to recognizable functions and offer a set of protocols by which they can be published, discovered, and used in a standards-based way. Organizationally, Web services are simply information technology (IT) assets that are often used as the basis for integration strategies that fuse content and capabilities in support of various processes and initiatives.

Web services provide the building blocks upon which broader IT strategies are based, such as the implementation of a Service-Oriented Architecture - SOA.

Spatially enabling a SOA requires knowledge of not only the organizational business processes but also of the robust capabilities and benefits that GIS offers. First, each process should be divided into common functions that can be delivered throughout the institution in conformance with the overall mission and goals of the organization, with services being created for each function. Second, each process should be evaluated with an understanding of how GIS technology can extend and enrich those processes by providing value in overall efficiency, accuracy, accessibility, and cost savings.



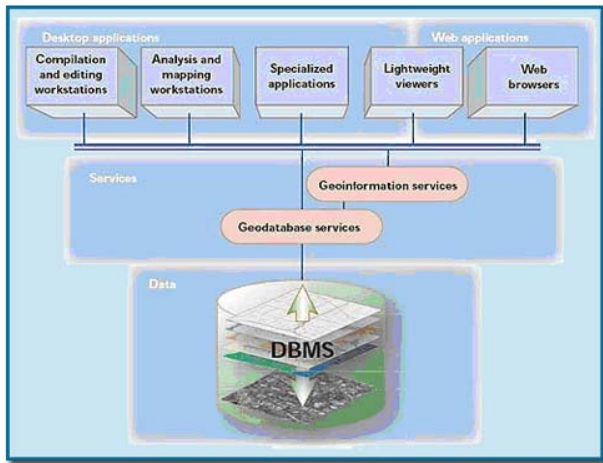


Fig. 1.2.1 A complete GIS platform

GIS have come to be an indispensable tool for analyzing and managing spatial data. Data pertaining to spatial attributes can be efficiently managed using Relational Database Management System (RDBMS).

The development of a Web-based system by integrating GIS and RDBMS serves two crucial purposes. Firstly it allows the user to operate the system without having to grapple with the underlying intricacies of GIS and RDBMS technology. Secondly, it allows sharing of information and technical expertise among a wide range of users.

The Geospatial Web or Geoweb is a relatively new term that implies the merging of geographical (location-based) information with the abstract information that currently dominates the Internet. This can create an environment where one could search for things based on location instead of by keyword only – i.e. “What is Here?”

The Geoweb would allow location to be used for self organizing all geospatially referenced data available all through the Internet.

The interest in Geoweb has advanced due to the availability of new technologies, concepts and products. Virtual globes such as Google Earth and NASA World Wind as well as mapping websites such as Google Maps, Windows Live Local and Yahoo Maps have been major factors in raising awareness towards the importance of geography and location as a means to index information.

### 1.3 Benefits of GIS-Based Services and Web Applications

Spatial data are a valuable information asset that can be used to support daily tasks and business decisions throughout an enterprise. However it is usually restricted to a handful of technical experts within GIS departments and is often duplicated between different offices and departments within the same organization.

GIS Web Applications can be used to eliminate duplication and inconsistency, and make location information conveniently and intuitively accessible across departments, at a lower cost per user. Non-professional GIS user gain easy and fast access to the centralized location analyses data to assist them in their day-to-day work.

Some of the characteristics, functionalities and advantages of using Web GIS technologies, are:

- rationalization of geographic dataset storage;
- simplification and automation of data transmission and acquisition;
- simplification of data access and data distribution, with the possibility of establishing different access and security levels;
- improvement of the continuous control on data flow, due to the possibility of integrating spatial analysis procedures on demand and instruments for the automatic detection of situation of interest;
- possibility of creating personalized interfaces by using PDA/wireless devices;
- automation of organization reporting (creating tables, diagrams, graphs..);
- integration with data belonging to different sources;
- data download (if possible) and possibility of printing the map of interest;
- direct access to all the meta information related to the data of interest

The Internet Map Server offers support for a variety of platform and server options, and this allows individual participating agencies to implement their own data systems and services.

Dissemination of GIS data and functionality has traditionally been restricted by difficulty with integration into traditional IT, analytical complexity, the size and format of data sets and the limitations of network bandwidth. These factors conspire to restrict GIS largely to a high end workstation application within GIS departments. Distributed access has been

both limited and relatively expensive.

Web applications offers distributed GIS access at a reduced per user cost. A highly cost-effective way to make geographic data and analyses more widely available and more accessible across an organization is to develop web applications. These can provide an easy-to-use, fast, and convenient method to access spatial data. This permits visualization and simple query of spatial information, but also complex spatial operations such as geocoding and route networking. Web applications also makes GIS cheaper by dramatically altering the cost-benefit ratios of GIS implementation when assessed against user accessibility.

Web services also permit web editing which offer organizations maintaining data a cost effective approach to disseminated editing functionality across either intranets or the Internet. This is of significance as it permits the update and maintenance of data within central data stores to be carried out remotely, allowing data to be updated from the field, site office or remote station.

## 2. ARCGIS SERVER TECHNOLOGY

### 2.1 What is ArcGIS Server?

ArcGIS Server is a complete and integrated server-based geographic information system (GIS) which is mainly used to share GIS resources across an organization and across the web. GIS resources are the maps, globes, address locators, geodatabases, and tools meant to be shared with others.

These resources are shared by first hosting them on the local ArcGIS Server system, or GIS server, and then allowing client applications to use and interact with the resources.

The main advantages of sharing the GIS resources on a GIS server are the same as sharing any data through any kind of server technology: the data is centrally managed, supports multiple users, and provides clients with the most up-to-date information.

ArcGIS Server comes with out-of-the-box end user services and applications for geodata management, visualization (mapping), and spatial analysis. It provides a rich, standards-based platform, extensive GIS capabilities, and comprehensive data management tools that promote a centrally managed GIS architecture.

ArcGIS Server provides the platform for sharing the GIS resources, such as maps, with the user community, whether they're sitting in the same office using ArcGIS Desktop or sitting everywhere else accessing and viewing maps through the Internet.

In addition to providing access to particular GIS resources, the GIS server also provides access to the GIS functionality that the resource contains. For example, it is possible to share a map with someone through a server, but it would be even better if that person could also interact with the map, like find the closest hospital, restaurant, or bank and then get directions to it from their location. Thus, the GIS server not only allows people to share resources, like maps, but also allows them to access the GIS functionality embedded in them.

How people use the GIS resources on the server depends on who they are. Some people will be fully aware of GIS servers and also of the particular resources on a given server because they need to use them directly. For example, a GIS analyst might author a map that contains a layer that references a map resource on a GIS server. Or a developer may build a web application that uses a map and an address locator to schedule and route

delivery trucks.

For other people, the details about GIS servers and GIS resources will be completely hidden from them. For example, the members of a city council may explore a map through a web application, for instance, finding locations suitable for redevelopment, before they make a decision that affects the community they live in. For them, the web application simply provides the tools and information to help them make their decision. The fact that the web application they're using to explore the map is accessing a particular map resource hosted on a GIS server is of no concern.

## 2.2 Main characteristics of ArcGIS Server – How does it work?

ArcGIS Server gives organizations the ability to centralize GIS software on application servers and deliver GIS capabilities to large numbers of users over networks. Enterprise GIS users connect to central GIS servers using traditional desktop systems as well as Web browsers and mobile computing devices. ArcGIS Server allows users, at the main office or regional offices, at home, or in the field, to access GIS capabilities through a single shared system.

ArcGIS Server spatial data management capabilities are based on the ArcGIS geodatabase model. The geodatabase provides the common data access and management ArcGIS Server: ESRI's Complete Server GIS framework for the ArcGIS family of products. ArcGIS Server geodata services allow administrators to publish geographic data so that it can be easily consumed during common workflows and user interactions with ArcGIS Desktop. ArcGIS Server can publish geographic data for extraction, checkout/check-in, and database replication.

ArcGIS Server visualization and mapping capabilities offer mapping services that support 2D dynamic and cached maps as well as 3D globes. Users can configure rich browser-based Web mapping applications that consume 2D services with point-and-click ease. Three-dimensional mapping services (including globes) can be used by ArcGIS Explorer, ESRI's lightweight client that is included with ArcGIS Server. ArcGIS Desktop can consume 2D and 3D mapping services.

ArcGIS Server spatial analysis capabilities offer server-based analysis and geoprocessing. This includes vector, raster, 3D, and network analytics; models, scripts, and tools; desktop

authoring; and synchronous processing.

With ArcGIS Server, implementation and all processing capabilities are handled in centralized applications, servers, and databases. This means that the day-to-day administrative costs of version synchronization, certification, software installation, and updates are significantly reduced.

Consolidated applications, database servers, and centralized data centers offer a number of advantages including:

- Reduced GIS software installation and maintenance costs
- Centralized management of data stores
- A more secure environment for data and applications
- Integration of GIS applications and data with other centrally hosted applications
- Reduced network bandwidth utilization between client software, file servers, and geodatabases
- Support for remote users on low-bandwidth connections

Because ArcGIS Server provides a complete, standards-based platform and extensive GIS capabilities, there is no need to install special software on the client machines. The intuitive, browser-based design of ArcGIS Server Web mapping applications reduces the need for GIS training of end users. The integrated architecture of ArcGIS means that existing ArcGIS Desktop users can immediately consume and use GIS services in their everyday workflows. With this open environment, organizations can provide geospatial capabilities to a wide range of distributed users with minimal investment in additional hardware, software, and infrastructure.

## 2.3 Interoperability and integration with other systems

ArcGIS Desktop users can author geoprocessing tools and publish them as services that can be used by Web mapping applications, ArcGIS Explorer, and ArcGIS Desktop.

ArcGIS Server, in conjunction with ArcGIS Desktop, offers a workflow that allows for greater productivity. It lets author data, maps, globes, and models on the desktop; serve them to a GIS server; and use them through Web, desktop, and mobile clients.

ArcGIS Server openness and compliance with standards allow services to be published

then consumed by many clients aside from those developed by ESRI.

ArcGIS Server adheres to IT standards, providing interoperability and compatibility with organization architectures using any of a variety of popular programming languages, development environments, commercial application servers, and database management systems (DBMSs).

ArcGIS Server technology supports interoperability standards in the GIS domain via the Open Geospatial Consortium, Inc.® (OGC®). ArcGIS applications are interoperable with clients that read and write Web Map Services (WMS). Using ArcGIS Server Manager, users can easily create OGC WMS-compliant mapping services and Web applications that use those services. This international standard defines a map to be a portrayal of geographic information as a digital image file suitable for display on a computer screen.

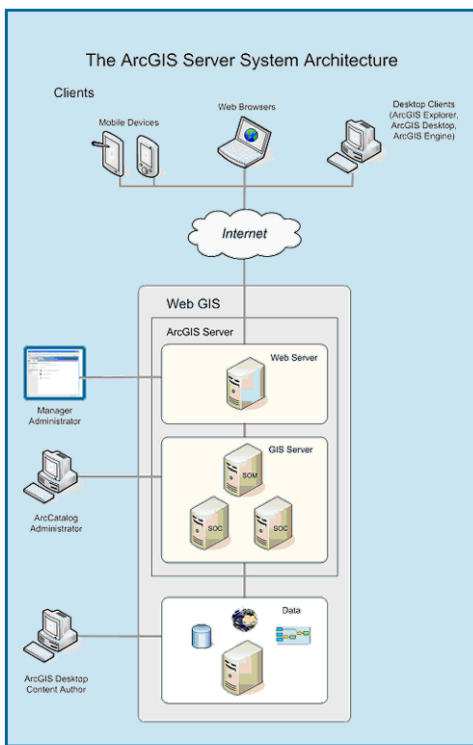
In the broader IT domain (World Wide Web Consortium [W3C]), ArcGIS applications are interoperable with clients that read and write KML. KML is the Google Earth™ XML specification that describes geographic features and rasters in three dimensions. ArcGIS Explorer and ArcGIS Desktop applications like ArcGlobe™ read KML. ArcGIS Desktop geoprocessing tools and ArcGIS Server GIS services can output vector features and raster data in KML.

Key IT standards, such as Java™ and .NET, XML, and SOAP, can be used for messaging and data transfer over Web (HTTP) network connections to build local and wide area network enterprise applications.

ArcGIS products have appropriate open application programming interfaces and support key data interchange formats and Web service standards for ensuring relevant GIS and IT interoperability between systems over wired and/or wireless networks.

## 2.4 The ArcGIS Server architecture

ArcGIS Server is a distributed system consisting of several components that can be installed across multiple machines. Each component in the ArcGIS Server system plays a specific role in the process of managing, activating, deactivating, and load balancing the resources that are allocated to a given server object or set of server objects.



*2.4.1 A distributed installation of ArcGIS Server can include many machines, which must be configured to communicate correctly*

ArcGIS Server is a distributed system consisting of one or more computers where the GIS server (the Server Object Manager (SOM) and Server Object Containers (SOC)), and Application Developer Framework (ADF) reside.

The SOM manages the set of server objects that are distributed across one or more SOC machines. The SOC machine host the server objects that are managed by the SOM. Each SOC machine is capable of hosting multiple SOC processes. A SOC process is a process in which one or more server objects are running.

The ADFs provide the framework, Web controls and convenience classes to build and deploy Web applications and Web services that make use of ArcObjects running in the GIS server. The ADFs require a Web server, and, in the case of the Java ADF, a servlet engine.

The ArcGIS Desktop (ArcInfo, ArcEditor, ArcView) products are the applications that provide the tools to create maps, address locators and so on, as well as administer the



various aspects of the GIS server. Specifically, the ArcMap application creates map documents (mxd), and with the optional ArcGIS Publisher extension, one can create Published Map Documents (pmf) which can then be served as GIS Server server objects. ArcCatalog both creates address locators for use in GeocodeServer server objects, and provides the tools for administrating the GIS server itself.

The ArcGIS Server has a scalable architecture that allows for deployment sizes ranging from one to many machines. When first installing ArcGIS Server, the appropriate configuration should be decided. It is possible to install all components on one machine for development and testing purposes and then considering the idea of a distributed installation of ArcGIS Server in order to achieve an acceptable level of performance for the number of users accessing the system.

A distributed installation of ArcGIS Server is when components of one ArcGIS Server system reside on multiple machines in the same local network. For example, the graphic in figure 2.4.1 depicts a distributed installation because the Server Object Manager (SOM), Server Object Containers (SOCs), and Web server reside on separate machines.

## 2.5 Main components of ArcGIS Server

ArcGIS Server is fundamentally an object server that manages a set of ArcObjects running on it. The ArcObjects being served are called GIS server objects. ArcGIS Server's server objects are software objects that treat a GIS resource like a map, locator, and so on. Applications created by developers make use of server objects. ArcObjects is a collection of software objects that make up the foundation for the family of ArcGIS products (ArcGIS Desktop, ArcInfo, ArcEditor, ArcView), ArcReader, ArcGIS Engine and ArcGIS Server.

The components of ArcGIS Server can be summarized as:

- GIS server - Hosts and runs server objects. The GIS server consists of a server object manager (SOM) and one or more server object containers (SOCs).
- Web server - Hosts Web applications and Web services that use the objects running in the GIS server.
- Web browsers - Used to connect to Web applications running in the Web server.
- Desktop applications - Connect over HyperText Transfer Protocol (HTTP) to ArcGIS Web services running in the Web server or connect directly to GIS servers over a LAN or WAN.

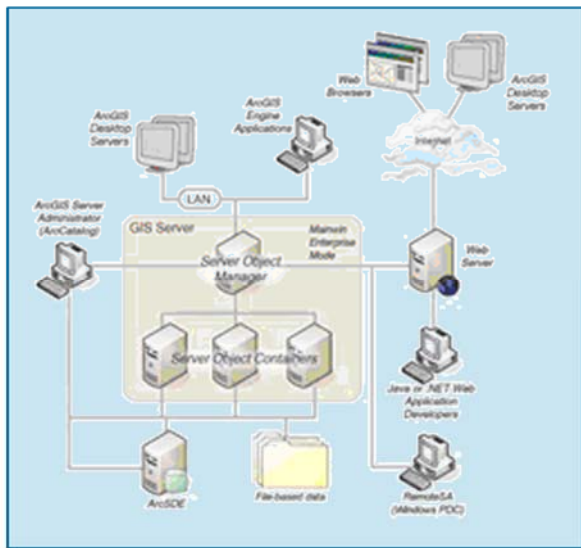


Fig. 2.5.1 Components of ArcGIS Server

## GIS SERVER

A server object is a software object that manages and serves a GIS resource such as a map or a locator. Server objects are managed and run within the GIS server. A server object may be preconfigured and preloaded in the server and can be shared between applications.

Server applications make use of server objects and may also use other ArcObjects that are installed on the GIS server.

The GIS Server is composed of:

The Server Object Manager (SOM)

A SOM is a Windows or UNIX service running on a single machine. The SOM manages the set of server objects that are distributed across one or more container machines. When an application makes a direct connection to a GIS server over a LAN or WAN, it is making a connection to the SOM, so the parameter that is provided for the connection to be made is the name or Internet Protocol (IP) address of the SOM machine.

The Server Object Containers (SOC)

The container machine (or machines) hosts the server objects that are managed by the SOM. Each container machine is capable of hosting multiple container processes. A

container process is a process in which one or more server objects are running. Container processes are started and shut down by the SOM.

The objects hosted within the container processes are ArcObjects components that are installed on the container machine as part of the installation of ArcGIS Server.

All server objects run on all container machines and are balanced equally across all of them. So, it is important that all container machines have access to the resources and data necessary to run each server object. It is also important to note that the GIS server assumes that all container machines are configured equally, such that they are all capable of hosting the same number of server objects.

#### The server directories

A server directory is a location on a file system. The GIS server is configured to clean up any files it writes to a server directory. By definition, a server directory can be written to by all container machines.

The GIS server hosts and manages server objects and other ArcObjects components for use in applications. In many cases, the use of those objects requires writing output to files. For example, when a map server object draws a map, it writes images to disk on the server machine. Other applications may write their own data; for example, an application that checks out data from a geodatabase may write the checkout personal geodatabase to disk on the server.

Typically, these files are transient and need only be available to the application for a short time—for example, the time for the application to draw the map or the time required to download the checkout database. As applications do their work and write out data, these files can accumulate quickly. The GIS server will automatically clean up its output if that output is written to a server directory.

A server directory can be configured such that files created by the GIS server in it are cleaned based on either file age or time since they were last accessed. The maximum file age is a property of a server directory. All files created by the GIS server that are older than or have not been accessed for the time defined by the maximum age are automatically cleaned up by the GIS server.

### 3. ARCGIS SERVER AT THE “SENSORS, RADAR TECHNOLOGIES AND CYBERSECURITY” UNIT

At the “Sensors, Radar Technologies and Cybersecurity” Unit we installed ArcGIS Server Enterprise 9.2 for Windows, which includes also ArcGIS Explorer 9.2 and ArcSDE 9.2 (ESRI Service Pack 4 included).

This version is designed for large organizations needing to share geographic data, maps, and analyses with the highest level of system flexibility and scalability. ArcGIS Server Enterprise can be implemented across a distributed computing environment and is designed to leverage various enterprise-class DBMSs.

#### 3.1 Planning the ArcGIS site configuration

There are many possible ArcGIS Server system configurations. It is possible to run all components of ArcGIS Server on a single computer, or to distribute the various components across multiple computers. Configurations will vary depending on the needs of an organization, the available computing resources, and the intended use of the ArcGIS Server system.

For the Server Object Containers, processing speed and the ability to handle load are important.

It is necessary to configure the ArcGIS Server system based on its intended usage and the number of simultaneous users. In case of a developer who intend to use the ArcGIS Server system to build and prototype applications, then it is better to install all the components on a single computer (the development computer). If the anticipated number of simultaneous users of the GIS server is low, satisfying on the order of 100 to 1000 requests per day, then it would be enough to run the entire system on one computer.

Getting into higher-volume usage of the GIS server and its associated Web applications, the system should be distributed across multiple computers.

#### ArcGIS Server on a single machine

This installation scenario consists of the GIS server (Server Object Manager, Server

Object Container), and Application Developer Framework on the Web server machine. Additionally, ArcGIS Desktop can also be installed on this machine if another machine is not available to install and run the applications necessary to administer the GIS server. In order to install all components of ArcGIS Server on a single machine, that machine must satisfy the installation requirements for both the GIS Server and the ADF of choice (.NET or Java).

This type of configuration is useful for those sites with limited computing resources, light server loads, or for developers who want to install ArcGIS Server for the purpose of developing applications.

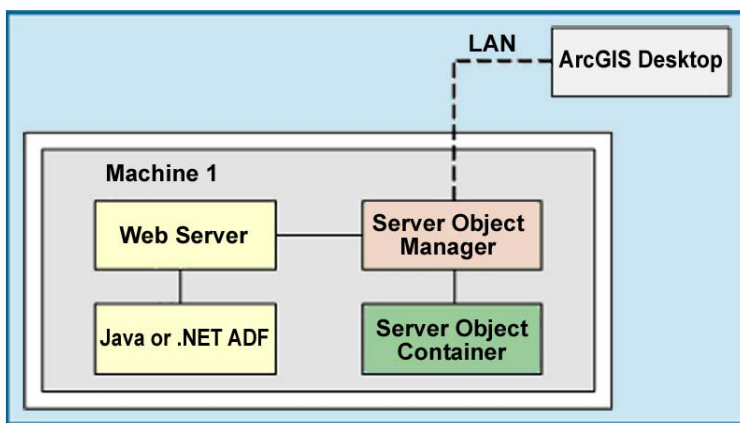


Fig. 3.1.1 Configuration on a single machine

The configuration in the diagram above illustrates the Web server, Application Developer Framework, and GIS Server (Server Object Container and Server Object Manager) on one machine. ArcGIS Desktop is shown connected to the Server Object Manager over a LAN. However, ArcGIS Desktop does not have to be on another machine, it could also be installed on this machine.

A distributed installation of ArcGIS Server provides the flexibility to scale out the deployment by adding more machines. Since the container processes do the GIS work and typically consume the most CPU resources, each SOC machine added to the system increases the number of users that the GIS server can accommodate.

## 3.2 Installation and configuration

ArcGIS Server has a scalable architecture which allows for deployment sizes ranging from

one to many machines. When first installing ArcGIS Server, it is better to choose to install all components on one machine for development and testing purposes. Once ready to deploy the ArcGIS Server application, a distributed installation of ArcGIS Server should be considered in order to achieve an acceptable level of performance for the number of users accessing the system.

Considering the status of the project, which is at the very beginning and the fact that we want to test the entire system before implementing it on the web, we stated to install all ArcGIS Server components on the same machine, called Cserv-gis02, in the subnet 139.191.42.0/24, a Windows 2003 stand alone configuration , with the following characteristics:

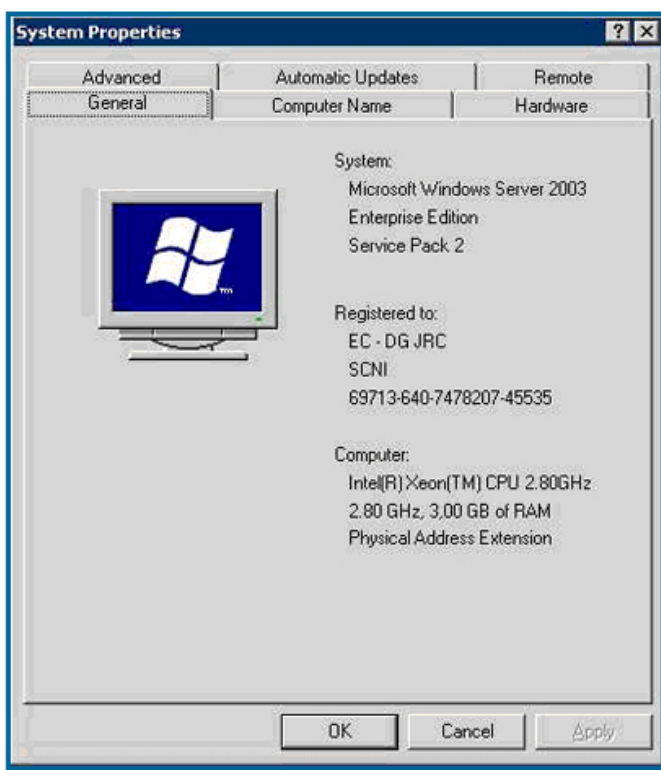


Fig. 3.2.1 Characteristics of the Server machine

### 3.2.1 Install the ADF: .NET Framework SDK v2.0

After installing any necessary prerequisites as detailed in the System Requirements, ArcGIS Server could be installed on the machine as defined in the configuration of the system.

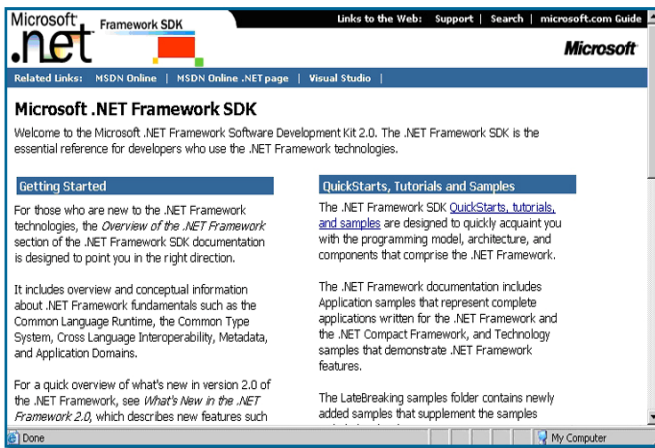


Fig. 3.2.1.1 Microsoft .net main page

### 3.2.2 Install ArcGIS Server components

Navigating through the ArcGIS Server Setup wizard, it is possible to find a panel that allows choosing which components, or features, of ArcGIS Server to install. For each machine, the necessary features should be chosen to perform its function in the system.

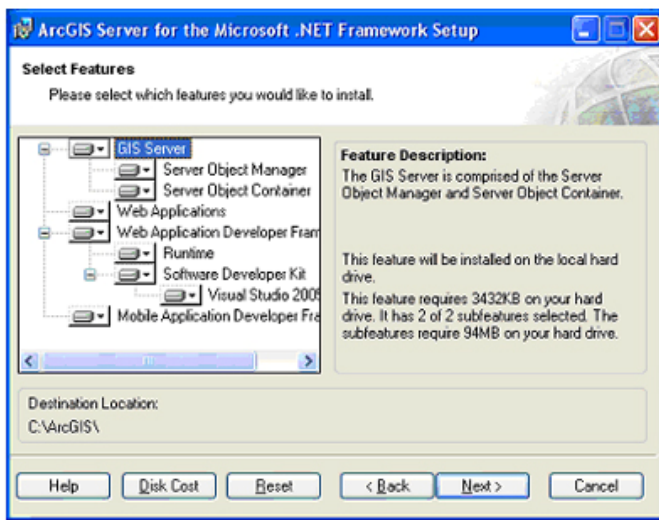


Fig. 3.2.2.1 Selecting which features of ArcGIS Server will be installed

### 3.2.3 Run the post installs

ArcGIS Server 9.2 has two post installation wizards: the GIS Server Post Install and the Web Applications Post Install.

The GIS Server Post Install has two parts: Configure ArcGIS Server, and Authorize ArcGIS Server.

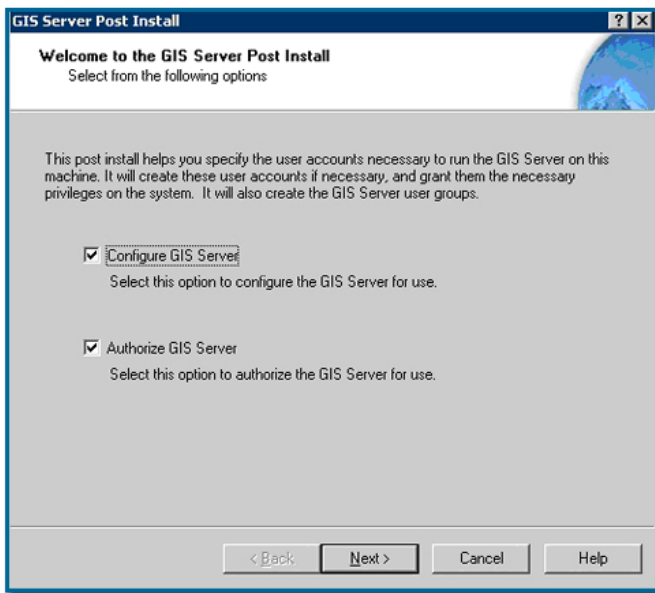


Fig. 3.2.3.1 GIS Server Post Install

During the GIS Server Post Install it is necessary to provide names and passwords for the accounts used by the GIS server, namely the SOM, SOC, and ArcGIS Web Services accounts. The GIS Server Post Install gives the option to save a configuration file that contains the names and passwords entered for the accounts. When running the GIS Server Post Install on other machines, it is possible to use the configuration file to quickly load the same name and password information.

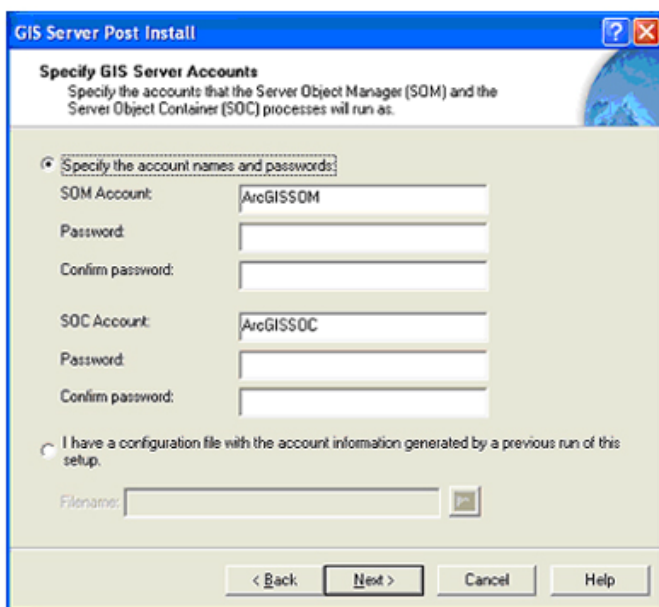


Fig. 3.2.3.2 This panel of the GIS Server Post Install prompts the user to specify the SOM and SOC accounts



It is important to note that in Windows Computer Management, the full names of the SOM and SOC accounts are the ArcGIS Server Object Manager Account and ArcGIS Server Object Container Account, respectively. When granting permissions to these accounts in Windows, the full name will appear.

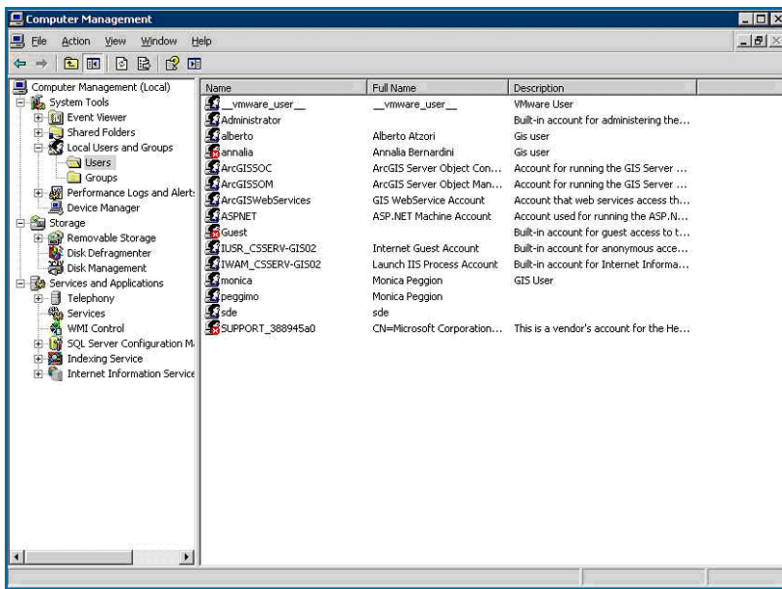


Fig. 3.2.3.3 Local Users properties

It is necessary to run the Web Applications Post Install on the Web server machine. This should be the machine on which the Web Applications components of ArcGIS Server are installed.

The primary purpose of the Web Applications Post Install is to link the Web server and the SOM in what is known as an ArcGIS Server instance. In large deployments of ArcGIS Server, configuring multiple instances can be a good way to organize the server system so that it can use a variety of licensing levels, security models, or application groups.

Consequently, the first thing to provide in the Web Applications Post Install is the name of the instance. The default name is ArcGIS. If the default is changed, it will change many of the default examples of URL structure and paths to server files mentioned in the ArcGIS Server Help.

Where prompted to enter the GIS Server, the name of the machine running the Server Object Manager (SOM) component of ArcGIS Server must be entered.

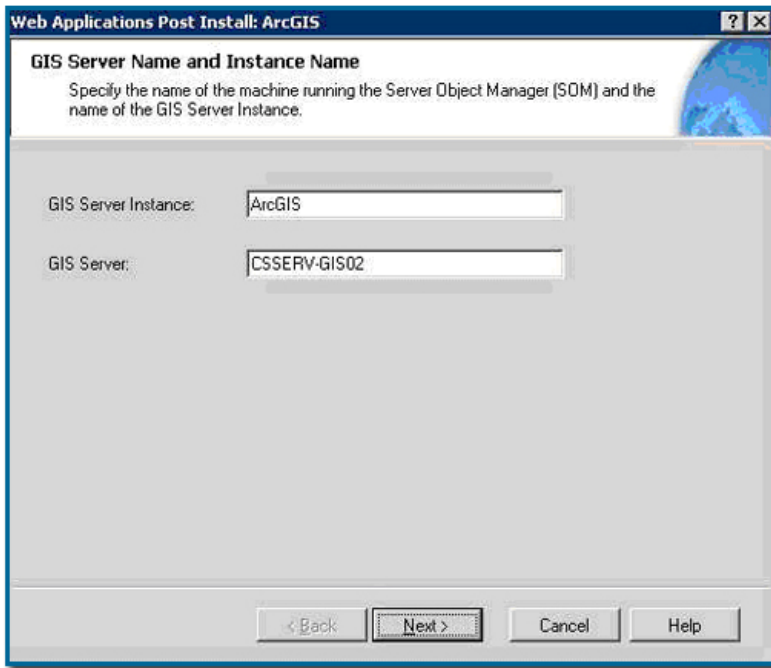


Fig. 3.2.3.4 GIS Server Instance and GIS Server properties

After running the post installs, this account is rarely used during the normal working operation, so, in most cases it's sufficient to accept the default.

Here it is necessary to use the same account entered when running the GIS Server Post Install on the SOM.

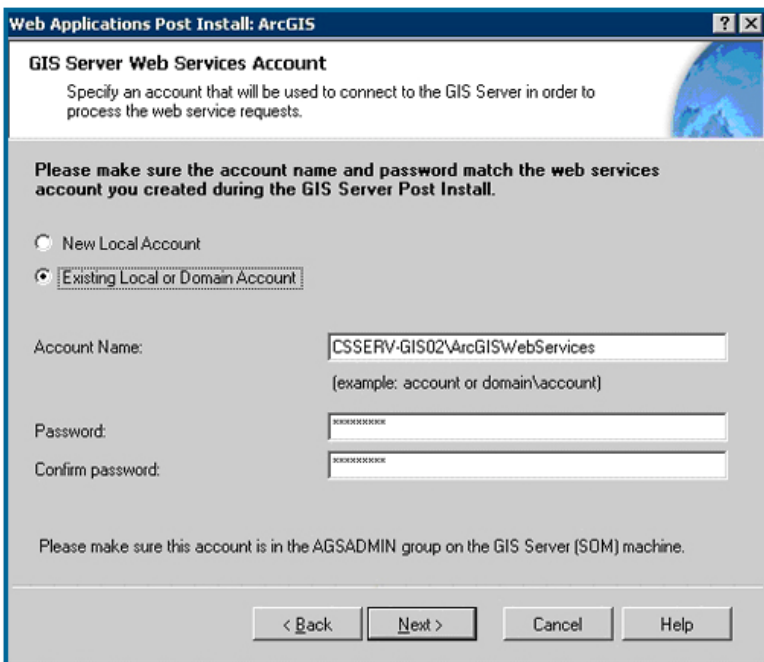


Fig. 3.2.3.5 GIS Server web services account

### 3.2.4 Add users to the agsadmin and agsusers groups

After running the appropriate post installs on the machine, it is necessary to specify which users will have administrative and regular-usage access to the server. The GIS Server Post Install creates two operating system groups on the SOM: agsadmin and agsusers. The agsadmin group is for administrators: for example, those who will add SOC machines and services to the server.

The server administrator and anyone else who will have the same privileges should be added to the agsadmin group on the SOM machine.

The agsusers group is for those who will be making local connections to the GIS server, but do not need administrative access. The agsusers group should be populated with a list of authorized users.

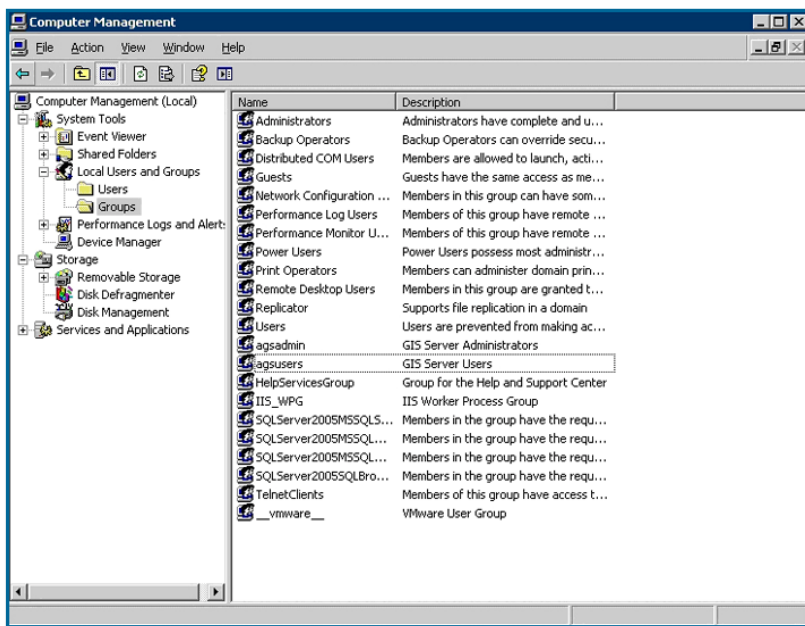


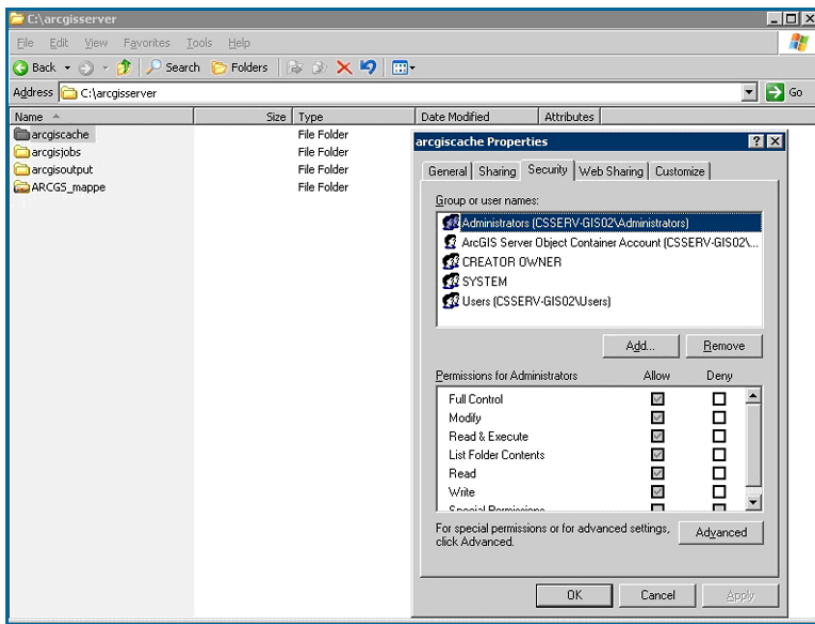
Fig. 3.2.4.1 Local Users properties

### 3.2.5 Prepare any server directories and Grant permissions to data directories

The GIS server makes use of three types of directories: Cache, Jobs, and Output. The server uses these directories to store map and globe caches, manage geoprocessing jobs, and write temporary files and output map images, respectively.

The SOC machine in the system needs to be able to access the server directories. To

make this possible, the folders representing the server directories to be shared should be configured, so that other machines on the network can access them.



### 3.2.5.1 Granting file permissions in Windows XP

The services created by ArcGIS Server rely on existing GIS resources. GIS resources are map documents, address locators, geodatabases, tools, and globe documents that users create using ArcGIS Desktop.

The SOC machine must have access to this data and this could be achieved maintaining one copy of the data in a shared folder. All SOC machines will access the data in this folder, using a UNC path.

We gave the SOC account permissions for each data folder in the same way that we granted the SOC account access to the server directories. So, after having shared the folder C:\arcgisserver\ARCGS\_mappe containing data which will be used by services, we granted Read, Write and Change share permissions to the SOC account.

This procedure applies not only to folders that contain the source documents, but also to folders that contain data referenced within the document. If the map document and the data reside in different directories, the user should grant permissions as described in the steps above for both the folder containing the map document, and the folder containing the data. A simpler solution is obviously to store the map document and its data in the same folder, as we did. This way we only had to grant permissions for one folder.

### 3.3 Accessing ArcSDE data

ArcSDE is the data retriever that communicates with the client and database. It provides files used for the setup and administration of the geodatabase.

There are two aspects of installing an ArcSDE geodatabase:

Installing and configuring the database management system (DBMS) software

Installing and configuring ArcSDE

The steps taken to accomplish this vary depending on the type of ArcSDE geodatabase in use and the DBMS used.

For ArcSDE Enterprise geodatabases, it is possible to use one of the following DBMS products: IBM DB2, IBM Informix, Oracle, or Microsoft SQL Server.

We decided to install and use the above mentioned Microsoft SQL Server.

#### 3.3.1 ArcSDE Enterprise geodatabases

There are three components to a new installation of ArcSDE Enterprise: preinstallation tasks, installing ArcSDE software, and postinstallation tasks.

##### Preinstallation tasks

The preinstallation tasks performed vary by DBMS and OS. On Windows systems, after having installed SQL Server, we had to set the TEMP environment variable to a writable folder.

##### Installing ArcSDE software

The installation files for ArcSDE Enterprise are on separate DVDs or CDs based on DBMS and OS type. On Windows systems, we used the install wizard to install ArcSDE.

##### Postinstallation tasks

The postinstallation tasks authorize the ArcSDE software and essentially create the geodatabase. The ArcSDE geodatabase schema gets created, the ArcSDE administrator user is created, if it doesn't already exist, and is given necessary permissions to the database, the ArcSDE software is authorized, and an ArcSDE service is set up and started.

So, the steps are the following:

Create the SDE user and grant it the required permissions. Also create the SDE user's default spatial database and add the SDE user to it;

Select configuration files and create geodatabase schema;

Authorize software;

Create and start an ArcSDE service.

The following operations were followed in order to administer a SDE geodatabase.

Installation of the ArcSDE software. For ArcSDE Enterprise, the DBMS and ArcSDE software must be installed separately.

Configuring the DBMS. The DBMS is the container for the data. We created the container (database) itself, and then we had to configure the database.

Creating user accounts. To control access to the geodatabase, we created user accounts with specific permissions.

Creating connections to the geodatabase. To work with the data, it is necessary to connect to the geodatabase from client applications. Connections can be made directly between clients and the database or between clients, the application server, and the database.

Maintaining the geodatabase. As the data in the geodatabase changes, the database administrator (DBA) performs tasks, such as compressing the database, updating statistics, performing backup and recovery procedures, and altering storage locations to maintain performance levels.

When using ArcSDE Enterprise geodatabases, the database administrator (DBA), who manages the DBMS, and the GIS administrator, who manages the GIS, often are not the same person. For this reason, it is important that the two individuals (or groups of individuals) coordinate their tasks.

The following is a list of some geodatabase management tasks and the corresponding staff person with whom responsibility for that task typically resides.

Task	Staff
Management of physical database structures (data files, tables, and indexes)	DBA
Management of logical database constructs (data models, rules, subtypes, networks, locators, and versions)	GIS administrator
Management of users and permissions	DBA (database permissions)
Database permissions	Data owner (object permissions)
Object permissions	
Database backup and recovery	DBA
Performance tuning	DBA (database)
Of the database	GIS administrator
Of workflows (how users utilize the GIS)	(workflows)
Data distribution (replication/synchronization)	GIS administrator
Geodatabase compression and updating statistics	GIS administrator

Many of these tasks will also require the DBA and GIS administrator to coordinate with other IT staff. For example:

- Deciding when scripted backups should be run to avoid conflicting with other scheduled processes
- Tracking down and fixing the cause of any performance issues encountered
- Coordinating network and server permissions with database permissions
- Determining the implications for the network, server access, and firewall if data is being transferred between the geodatabase and other enterprise databases or between the geodatabase and Web applications.

ArcSDE Personal and Workgroup geodatabases

For ArcSDE Personal and Workgroup geodatabases, administration is incorporated into ArcGIS Desktop; therefore, the GIS administrator will likely perform all geodatabase management tasks.

Additional staff, other than the GIS administrator, can be granted the ability to perform geodatabase administration tasks on specific geodatabase.

## 3.4 Publishing GIS Services and creating web mapping applications

### 3.4.1 Connect to the GIS server and add SOC Machines

In order to connect to the GIS Server and to administer it, it is possible to use either Manager or ArcCatalog. Manager, which gets installed when selecting the “Web Applications” component, should be installed on the Web server machine. ArcCatalog does not have to be installed on the same machine as any of other ArcGIS Server components; it just has to be on the same local network and not behind any firewalls.

ArcGIS Server cannot function without machines that host SOC processes. Before creating and using services, it is necessary to inform the SOM which machines will function as SOC.

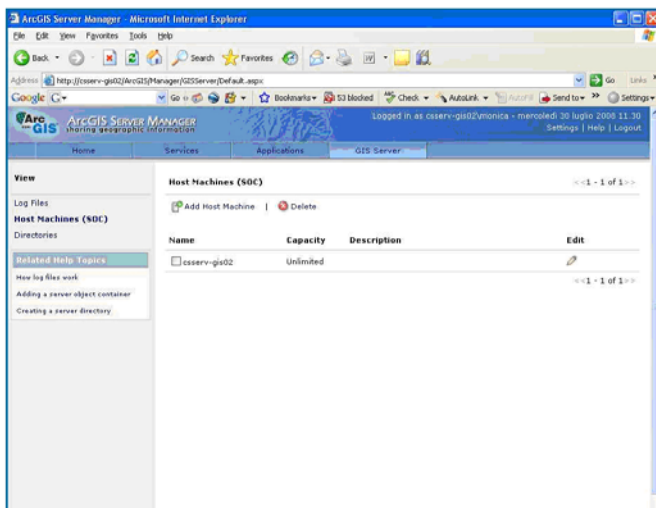


Fig. 3.4.1.1 Adding SOC machine csserv-gis02 with Manager

Before adding the SOC machines to the server, it is important to have run the GIS Server Post Install on each machine and have granted the SOC account permissions to the data and server directories that it will need to access.



### 3.4.2 Add GIS services

When connections are established to the server, and the server directories, data directories, and SOC machines are in place, it is finally possible to publish GIS resources on the server as services.

A GIS service represents a GIS resource, such as a map, globe, locator, or geodatabase connection, that is located on the server and is made available to client applications.

Services make it easy to share the use of resources across clients. The server stores the resource, hosts the service, and does the GIS work, sending back a common format of results, such as images or text, to the client.

The ArcGIS Desktop applications ArcMap, ArcCatalog, and ArcGlobe are used to author or create GIS resources. For example, a map document is created using ArcMap.

An address locator or geodatabase is created using ArcCatalog. A globe document is created using ArcGlobe, and a toolbox is created using either ArcMap or ArcCatalog.

Once a GIS resource is created, it can be published to the GIS server.

ArcGIS Server Manager offers an easy-to-use wizard for creating services. From Manager, users can also add and remove services, edit service properties, and organize services in folders.

ArcCatalog can also be used to publish a GIS resource to the server by navigating to the resource in the Catalog tree, right-clicking on it, and clicking Publish to ArcGIS Server.

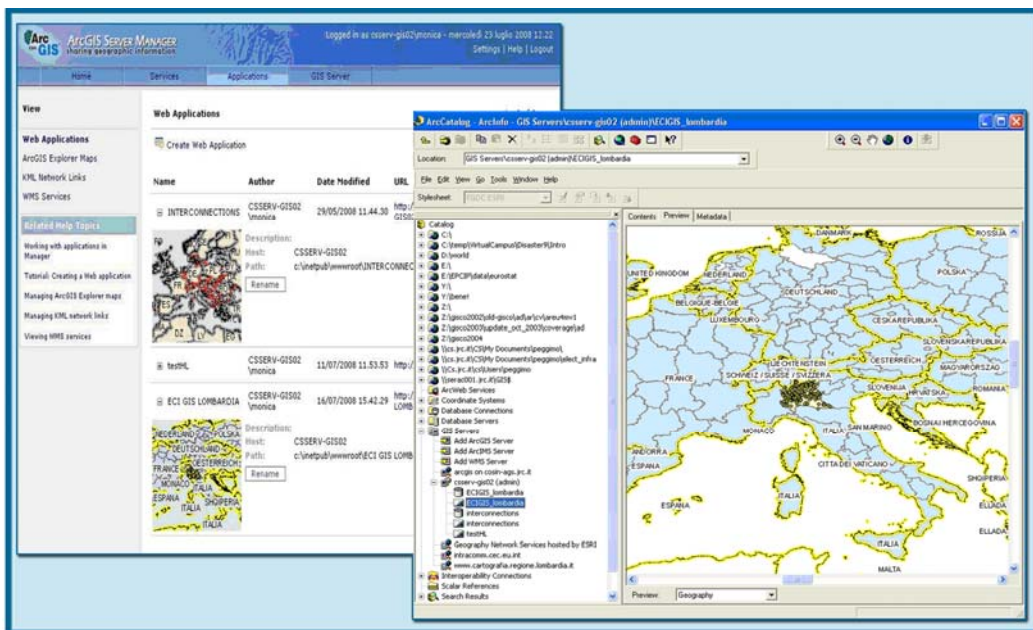


Fig. 3.4.2.1 ArcCatalog and ArcGIS Server Manager are both used for publishing web services

When publishing a GIS resource, using Manager or ArcCatalog, it can be enabled with capabilities that define the various ways clients can use the service. For example, a mapping service might be enabled with geocoding capability to allow someone using the service to find a place by its address.

Manager or ArcCatalog can be used to publish and enable a variety of different services.

The capabilities that are available for a resource vary depending on what type of GIS resource is used and, in the case of a map document, which layers are inside.

- A mapping service provides access to the contents of a map document (.mxd) or a published map document (.pmf). This capability is always enabled when publishing a map service.
- The Web Map Service is an Open Geospatial Consortium, Inc.-compliant map service that meets the international standard for Open Geodata Interoperability Specification (OGIS). The service can be consumed by any client that supports the OGC WMS specification including ArcGIS Desktop and Web mapping applications created with ArcGIS Server. WMS capability is always available when publishing a map service.
- A mobile data service provides mobile applications with access to the contents of a map document through a Web service. Mobile Web services are designed to be consumed by mobile applications running in handheld devices, such as Pocket PC, Tablet PC, and Smartphone, which have hardware limitations in display, memory, and processing power. Mobile capability is always available when publishing a map service.
- A globe service provides access to a 3D view of a globe, originating from an ArcGlobe document (.3dd). Supported clients, such as ArcGlobe, ArcGIS Explorer, and ArcReader™, can access the globe service remotely.
- A Keyhole Markup Language service uses the Google Earth XML specification that describes geographic features and rasters in three dimensions. The service can be consumed by ArcGIS Explorer, Google Earth, and ArcGlobe. KML capability is always available when publishing a map service.
- A geoprocessing service provides access to geoprocessing models that run on the server and allows organizations to centralize geodata and geoprocessing operations. Once published, geoprocessing services can be used by a number of different client applications including ArcGIS Explorer, Web mapping applications, and ArcGIS Desktop. If a toolbox

containing the geoprocessing operations the user wants to run in a model or group of models has been published to the GIS server or the models have been added to the ArcMap table of contents as tool layers and published to the GIS server, then the geoprocessing capability is available when publishing a map service.

- A geodata access service provides access to a geodatabase through the LAN, WAN, or Internet using ArcGIS Server. The service exposes the ability to perform geodatabase replication operations, make copies using data extraction, and execute queries in the geodatabase. The geodatabase can be published directly to create a geodata service, or the user can publish a map document that includes a geodatabase to create a geodata service and a corresponding map service. The GIS resource must

be an ArcSDE® connection file (.sde), personal geodatabase, file geodatabase, or a map document with a layer from a geodatabase.

- A network analysis service provides access to transportation network analysis operations such as routing, closest facility location, or service area analysis. These services use the ArcGIS Server Network extension to perform analysis on a network dataset. A Network license is required on the server, and the map document must contain a network analysis layer. The service can be consumed using the developer tools included with ArcGIS Server.

- A geocode service allows users to type an address and receive a map with the geocoded result. Once the service is created, developer tools included with ArcGIS Server can be used to consume the geocode service in client applications. An address locator (an address locator file [.loc], ArcView® 3 locator [.mxs], ArcSDE locator, personal geodatabase locator, or file geodatabase locator) must be created as a GIS resource using ArcGIS Desktop, then published to the GIS server.

High-performance mapping services can be created by caching them for use at particular map scales. Mapping services with a map cache draw much faster than those without a cache because the server simply returns one or more precreated, cached images to the client instead of dynamically creating one at the time of request. ArcCatalog or caching geoprocessing tools located in ArcToolbox can be used to create cached mapping services.

Manager offers a simple wizard for creating a Web mapping application. It also includes mechanisms for publishing ArcGIS Explorer maps and KML network links on the server. Manager is used to configure the functionality of the Web mapping application by choosing from a list of powerful out-of-the-box tasks including editing, find address, find places, geoprocessing, query attributes, and search attributes. Manager can also be used to customize the look and feel of the application, with no need of Web development or programming experience to configure the Web mapping application.

ArcGIS Server allows the Web mapping application to seamlessly integrate mapping services running on the same GIS server or different GIS servers including ArcGIS Server Internet connections (via HTTP), ArcGIS Server local connections, ArcIMS® image services, and ArcWebSM Services hosted by ESRI. For example, a service running on an ArcIMS server can be combined with one running on ArcGIS Server.

Manager also makes it possible to configure the machines and directories in the server system and troubleshoot the server using its logs. Server administration means setting up and adjusting the appropriate hardware, software, and settings so that the ArcGIS Server system runs as smoothly as possible and meets user needs.

Through Manager, ArcGIS Server provides a number of administrative tools including:

- Starting, stopping, deleting, and pausing services - Manager gives administrators control over the availability of machine resources. For example, if the mapping services reference a server containing a geodatabase and that server is down for maintenance, an administrator can pause the map service until the database is available again. Services can also be permanently removed.
- Adding and removing folders - Manager is used to organize services in folders.

The folders can be based on geographic regions, levels of security, Web service messaging format, or other criteria.

Creating server directories - These directories represent physical directories on the network that are accessible to all the server object container (SOC) machines of the GIS server. There are three types of server directories: Cache, Jobs, and Output. As needed, the GIS server writes temporary files to one or more of these directories.

The server also periodically cleans these directories by deleting files within them at a specified interval.

- Specifying the log file location - Log files are an important tool for monitoring and troubleshooting problems with the GIS server. The GIS server's logs maintain a record of all events in the server and are not deleted when the server is stopped. Log files can be viewed in Manager.
- Adding SOC's and setting the capacity of an SOC - Manager is used to quickly add SOC machines to the ArcGIS Server configuration. The SOC machines host services and are the work centers of the GIS server.
- If one of the SOC machines is considerably more powerful than the others, setting a high-capacity value on that machine and a lower value on the other machines may improve performance.

A second way to administer the GIS server is through the GIS Servers node in ArcCatalog. Manager can perform all the administrative functions that are available in ArcCatalog except for creating map and globe caches.

### 3.4.3 Client Applications

ArcGIS Server supports a broad range of clients, including:

- ArcGIS Explorer - ArcGIS Explorer is a lightweight client that is included with ArcGIS Server. It offers an easy way to deliver access to GIS content and capabilities. ArcGIS Explorer supports 3D mapping services as well as geoprocessing services for spatial analysis. With ArcGIS Explorer, users can consume and fuse standard Web services including those from ArcGIS Server, ArcIMS, WMS servers, and others.
- Web Mapping Applications - ArcGIS Server delivers out-of-the-box browserbased applications called Web mapping applications. These applications can be configured with out-of-the-box tasks such as querying or editing. Web mapping applications support 2D mapping services and other analytical services (e.g., geocoding and geoprocessing).
- ArcGIS Desktop - ArcInfo®, ArcEditor™, and ArcView can be used as desktop clients to author, publish, and consume ArcGIS Server capabilities. Out of the box, ArcGIS Desktop supports 2D services; 3D services are supported with the ArcGIS 3D Analyst™ extension. ArcGIS Desktop can act as a client to ArcGIS Server.
- ArcGIS Mobile - ArcGIS Server Software Developer Kit (SDK) supports mobile

application development for the .NET platform. It includes a set of tools for building and deploying 2D mobile applications that are powered by ArcGIS Server.

ArcGIS Mobile allows developers to build geocentric applications that provide basic GIS functionality including map display and navigation, GPS support, and GIS editing.

In addition, ArcGIS Server supports a series of open APIs and standards that allow virtually any other client (e.g., CAD, GIS, image processing, and SQL-based applications) to interact with and use the mapping, spatial analysis, and data management services of ArcGIS Server. These services can also be called on, and integrated with, other Web services using standard Web service protocols such as SOAP and XML.

## **4. ECI GIS PROJECT – THE GEOGRAPHIC INFORMATION SYSTEM OF THE EUROPEAN CRITICAL INFRASTRUCTURES**

### **4.1 The ECI GIS main objectives**

The main purpose of the project is to create an interactive Geographic Information System, which will let:

- The identification of the ECI over the European territory;
- The storage and the visualization of the appropriate information;
- A base for further risk analysis elaborations and models.

The basic idea is to create a database storing all the information related to each ECI, and establishing a connection with the map representation for the correct visualization of both the infrastructures and the entire network.

In the database all the administrative, technical, geographical information related to each ECI are stored. A specific section related to security issues will be also created, with particular access restrictions.

Each qualified user has the possibility to visualize or modify all the information, both using the database manager or the Web GIS Application, since they are completely and dynamically connected.

In order to develop the entire system, the choice for the application was ArcGIS Server, the ESRI product already discussed in this document.

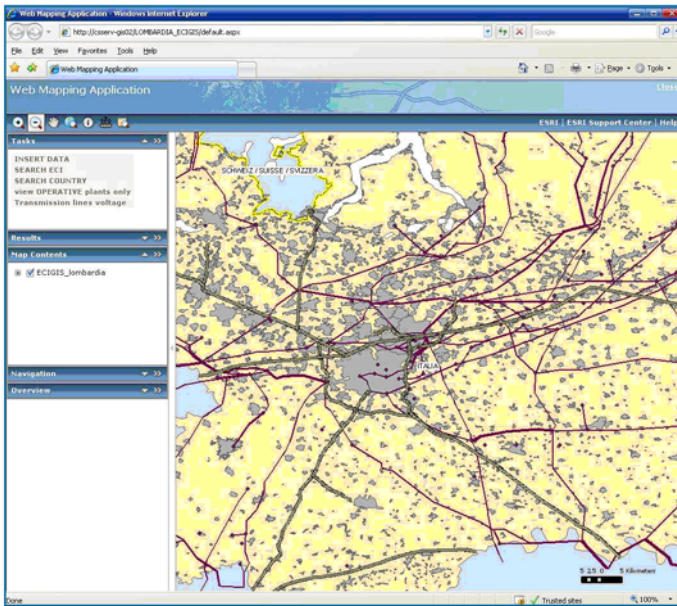


Fig. 4.1 ECI GIS web GIS application using ArcGIS manager

A prototype of ECI GIS project has been developed during 2008. This product is available only in a restricted area within the “Sensors, Radar Technologies and Cybersecurity” Unit of IPSC, inside the JRC Ispra. Once the system will be deployed also outside the JRC, the license requirements related to the background database should be verified and planned again.

## 4.2 Main thematic maps and database in use

Each user will have the possibility to choose the infrastructure of its competence, either using the database or the map representation, by the traditional search and find tools. In order to create the background maps and dataset for the prototype we decided to use the following database:

Satellite imagery (Landsat mosaic), Euroglobal Map. High resolution satellite imagery (IKONOS) could be acquired for specific analysis.

GISCO database – GISCO is the Geographic Information System for the European Commission. Originally conceived as a prototype GIS cell that would serve a wide spectrum of users and uses, the GISCO project has developed a service-oriented dimension, namely in geographical database development, thematic mapping, desktop mapping and dissemination of data.



The ECI GIS project will use the NUTS codes (Nomenclature of Territorial Units for statistics) as its standard location code.

Teleatlas - MultiNet is a Netherlands-based company which delivers digital maps and other dynamic content for navigation and location-based services, including personal and in-car navigation systems, and provides data used in a wide range of mobile and internet map applications.

The company provides maps covering 200 countries around the world providing mapping data and "Map Enhancement Products" such as points of interest and address points.

Platts is a provider of energy information around the world that has been in business in various forms for more than a century and is now a division of The McGraw-Hill Companies. Products include Platts Energy Economist, industry news and price benchmarks for the oil, natural gas, electricity, nuclear power, coal, petrochemical and metals markets.

ECI GIS project will use data related to the European Electric Network: Generating Stations, Substations, Cross border sections, Transmission lines.

The license agreement implies, for the moment, that data will be used only inside the Institute.

The Union for the Co-ordination of Transmission of Electricity (UCTE) is an association of electricity distribution network operators in Continental Europe. It operates a single phase-locked 50 Hz mains frequency electricity grid that supplies over 400 million customers in 22 countries, including most European Union members.

The ECI GIS project, as will focused in the first stages on the power infrastructure, is interested in making specific elaboration using consumption and production data, annual statistics at national or regional level; specific data related to cross border sections which are periodically published on the website.

EUROSTAT tables – All sort of statistical data at every NUTS level, such as: general and regional statistics, population and social conditions, industry, trade and services, agriculture, forestry and fisheries, transport, environment and energy.

### 4.3 ECI GIS components

Each user has the possibility to visualize and to edit the information both using the web gis application and the pure database. They are dynamically and completely connected by using the traditional GIS tools, which stay behind the scene and they can not be viewed outside. The specific GIS tools are the central point of the system, even if they don't appear to the final users, who don't need to have particular GIS skills. By the GIS tools it is possible to create SDE geodatabase, and moreover prepare the GIS service upon which the web application is created.

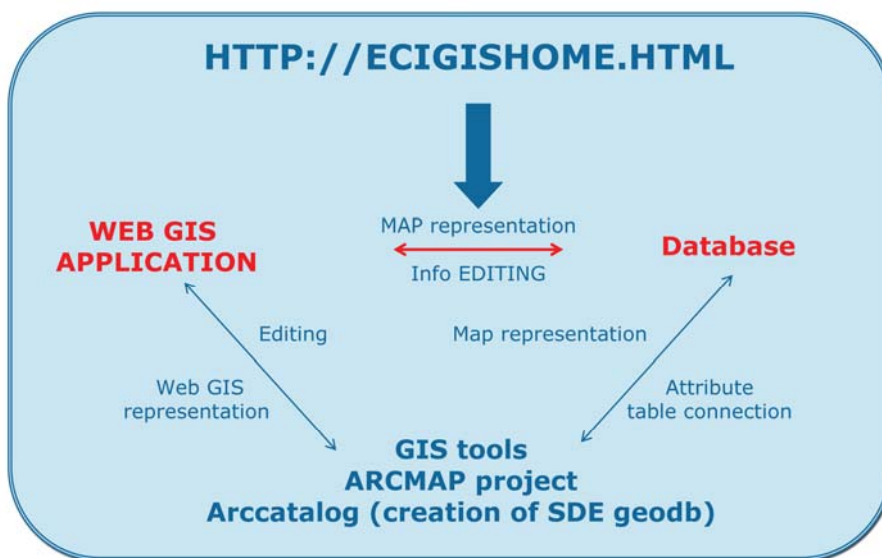


Fig. 4.3.1 ECI GIS main components

According to the schema, each user has the possibility to visualize and to edit the information both using the web gis application or the pure database. They are dynamically and completely connected by using the traditional GIS tools, which stay behind the scene and are not visible from outside. The GIS tools are the central point of the system, even if they don't appear to the final user. By the GIS tools it is possible to create SDE geodatabase, and moreover prepare the GIS service upon which the web application is created.

A web site has been created, with the intention of representing the eventual access point for all qualified users. Starting from the Home Page, the users will have the possibility to navigate through the ECI database, view the maps or simply read more information about the project and what is behind its development.

## Publish GIS map on the WEB

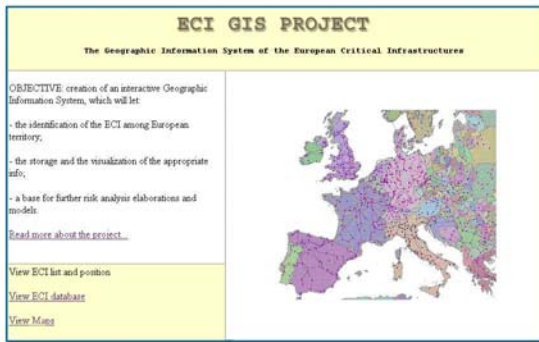


Fig. 4.3.2 Prototype of ECI GIS HOME PAGE

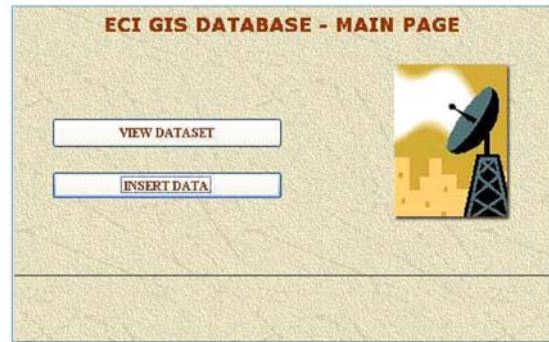


Fig. 4.3.3 How ECI GIS database main page

The information will be automatically stored in a central database, managed by a unique administrator, and implemented by each qualified user. Those information sets are of different kind: administrative, technical, geographical and security-related.

By creating specific links associated to each element in the map, the user has the possibility to connect directly to the database, and viewing all the info related to the element. The qualified user has also the ability to modify the database, by using the specific ArcGIS Server editing tools.

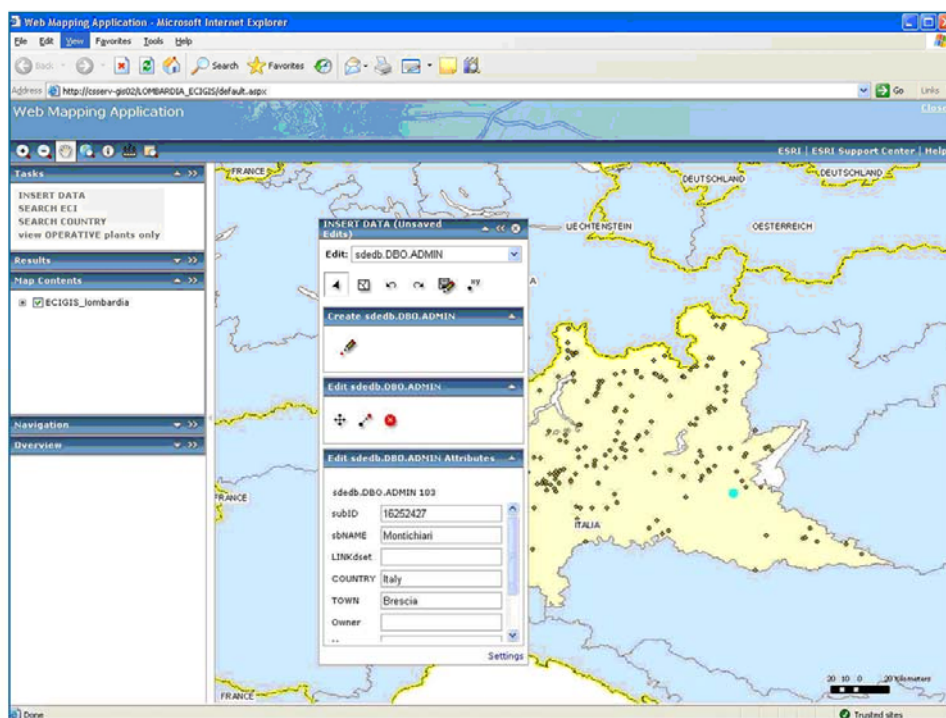


Fig. 4.3.4 How to edit the ECI database using the WEB GIS application with ArcGIS manager

On the basis of all the information stored for each ECI, it would be possible to create many elaborations showing the interaction between the infrastructures or visualizing specific scenarios.

ArcGIS Server contains certain tools which let not only the applications of simple query, but also more complex data geoprocessing.

## 4.4 The Spatial data Infrastructure

Spatial Data Infrastructure (or SDI) is a framework of spatial data, metadata, users and tools that are interactively connected in order to use spatial data in an efficient and flexible way. SDI is the technology, policies, standards, human resources, and related activities necessary to acquire, process, distribute, use, maintain, and preserve spatial data

Some of the main principles are that data and metadata should not be managed centrally, but by the data originator and/or owner, and that tools and services connect via computer networks to the various sources. A GIS is often the platform for deploying an individual node within an SDI. To achieve these objectives, good coordination between all the actors is necessary and the definition of standards is very important.

Due to its nature (size, cost, number of interactors) an SDI is usually government-related. An example of an existing SDI is the National Spatial Data Infrastructure (NSDI) in the United States. At the European side, INSPIRE is a European Commission initiative to build a European SDI beyond national boundaries and ultimately the United Nations Spatial Data Infrastructure UNSDI will do the same for over 30 UN Funds, Programmes, Specialized Agencies and member countries.

### 4.1.1 The INSPIRE initiative

INSPIRE stands for "Infrastructure for Spatial Information in Europe". It is a Directive (Dir. 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community, published in the official Journal on the 25th April 2007, entered into force on the 15th May 2007), aiming to assist policy-making in relation to policies and activities that may have a direct or indirect impact on the environment. INSPIRE is based on the infrastructures for spatial information

that are created by the Member States and that are made compatible with common implementing rules, supplemented with measures at Community level.

The Directive will improve the accessibility and interoperability of spatial data by laying down general rules applying to data and services held by or on behalf of public authorities and by private operators who choose to make their data available through the INSPIRE infrastructure. Spatial data and services will be accompanied by "metadata" making it easier to search them and assess their quality and potential use.

Detailed technical rules are under development for a wide range for spatial data themes in order to make it easier for different data sets to be combined. This involves standardisation of formats and nomenclatures so that the data sets can be combined seamlessly and without manual intervention, which greatly increases the range of uses that can be made of the data.

The general situation on spatial information in Europe is one of fragmentation of datasets and sources, gaps in availability, lack of harmonization between datasets at different geographical scales and duplication of information collection. These problems make it difficult to identify, access and use data that is available.

Awareness is growing at national and at EU level about the need for quality geo-referenced information to support understanding of the complexity and interactions between human activities and environmental pressures and impacts.

The INSPIRE initiative is therefore timely and relevant but also a major challenge given the general situation outlined above and the many stakeholder interests to be addressed.

The initiative intends to activate the creation of a European spatial information infrastructure that delivers to the users integrated spatial information services. These services should allow the users to identify and access spatial or geographical information from a wide range of sources, from the local level to the global level, in an inter-operable way for a variety of uses. The target users of INSPIRE include policy-makers, planners and managers at European, national and local level and the citizens and their organizations. Possible services are the visualization of information layers, overlay of information from different sources, spatial and temporal analysis, etc.

INSPIRE should be based on the infrastructures for spatial information that are created by the Member States and are designed to ensure that spatial data are stored, made available and maintained at the most appropriate level; that it is possible to combine

spatial data from different sources across the Community in a consistent way and share them between several users and applications; that it is possible for spatial data collected at one level of public authority to be shared between other public authorities; that spatial data are made available under conditions which do not unduly restrict their extensive use; that it is easy to discover available spatial data, to evaluate their suitability for the purpose and to know the conditions applicable to their use.

For these reasons, the Directive focuses in particular on five key areas: metadata, the interoperability and harmonisation of spatial data and services for selected themes (as described in Annexes I, II, III of the Directive); network services and technologies; measures on sharing spatial data and services; coordination and monitoring measures.

The Directive identifies what needs to be achieved, and Member States have to bring into force national legislation, regulations, and administrative procedures that define how the agreed objectives will be met taking into account the specific situation of each Member State.

## 5. CONCLUSIONS

Web-based GIS, the synergy between GIS and Web technologies, are demonstrating their usefulness. The World-Wide-Web is a useful tool for the gathering, accessing and manipulating data from different sources. The same is true for the deployment and exploitation of GIS information. Where formerly an individual would have to have access to isolated software packages to see and handle the data needed for GIS, nowadays more powerful applications can be deployed over private intranets and the public Internet.

It is well known that Geographic Information Systems (GIS) have come to be an indispensable tool for analyzing and managing spatial data. Data pertaining to spatial attributes can be efficiently managed using Relational Database Management System (RDBMS). Web-based GIS can potentially make distributed geographic information available to a geographically distributed audience. Users with Internet access can be empowered to access GIS applications from their browsers without purchasing proprietary GIS software.

GIS web applications built using web services also permits geospatial information to be directly integrated with applications that have no spatial functionality by themselves. This has significantly reduced the cost per user ratio.

The ECI GIS project will develop prototypes that could be used also in support of the Directive COM(2006) 787 on the identification and designation of European Critical Infrastructure and the assessment of the need to improve their protection.

According to that document Member States will be asked to identify the European Critical Infrastructures within their jurisdiction and to transmit a series of information associated to them to the European Commission.

The concepts and tools that will be developed in the ECI GIS system could help the Commission to organize this transmission procedures in a rational and efficient manner, giving the Member States the possibility to pass the info required simply acceding to a specific web site, filling a predefined form, using the most efficient GIS tools, adopting all the required security measures. This way the information will be automatically stored in a central database, completely managed by the Commission, its unique owner and administrator.

The benefits of using web based GIS for the management of information are:

- Creation of an organization-wide information center which combines graphical and textual information, providing users one-stop access to location-based information;
- Encourage more effective use of staff and resources, with centralised expert support;
- Provide a strong tool to support decisions by making more complete, accurate, and current data easily accessible and understandable.

Difficulties in disseminating data have meant that often the same data are duplicated by each user employing them – e.g. duplicating complete copies of the same base map. This is not only wasteful in storage; it incurs a significant overhead in data management and update, and inevitably leads to inconsistency between the datasets used by different organizations (or parts of organizations). An irregular, unintegrated workflow requires more time, energy and money.

With web services GIS, geospatial information is readily available to all who need it. Whether it be administrators, finance, researchers, or constituents. All authorized users can securely access necessary geospatial information no matter where it resides, what format it takes, or how quickly it changes - and integrate it into their daily workflow. This greatly reduces fragmented and compartmentalized workflows and communication, and increase efficiencies.



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## **Abstract**

It is well known that Geographic Information Systems (GIS) have come to be an indispensable tool for analyzing and managing spatial data. The synergies between GIS and Web technologies, the Web-based GIS, are also demonstrating their usefulness. With web services GIS, geospatial information is readily available to all who need it. Whether it be administrators, finance, researchers, or constituents. All authorized users can securely access necessary geospatial information and integrate it into their daily workflow. This greatly reduces fragmented and compartmentalized workflows and communication, and increase efficiencies.

ArcGIS Server, a ESRI GIS software, is a complete and integrated server-based geographic information system (GIS) which is mainly used to share GIS resources across an organization and across the web. ArcGIS Server gives organizations the ability to centralize GIS software on application servers and deliver GIS capabilities to large numbers of users over networks.

This report describes in detail all the procedures needed to install and to put into operation ArcGIS server at the “Sensors, Radar Technologies and Cyber-security” Unit of the Institute for the Protection and Security of the Citizens. Finally, every component is working correctly and each qualified user has the possibility to create and to publish their GIS maps.

ArcGIS Server is a fundamental instrument used also to develop the ECI GIS project (the GIS of the European Critical Infrastructures). The ECI GIS project will realize prototypes that could be used also in support of the Directive COM(2006) 787 on the identification and designation of European Critical Infrastructure and the assessment of the need to improve their protection, helping the Commission to organize the transmission procedures foreseen in the Directive in a rational and efficient manner, by using ArcGIS Server tools.

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